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FOUR DESIGNS FOR REBUILDING BRISTOL BRIDGE.

(Humbly inſcrib'd to the Gentlemen appointed
COMMISSIONERS for building the ſame)

WHEREIN ARE EXPLAINED

I. A Deſign of three Semicircular Arches on the Old Foundation.
II. A Deſign of three Eliptical Arches (alſo) on the old Foundation, chiefly calculated to ſave Expence, &c.
III. A Deſign of five Segment Arches on a new Foundation.
IV. A Deſign of an Arch 130 Feet Cord, and Altitude 29.
V. The Properties of the different Quarry STONES uſed in England, and which are moſt fit for a Work of this Kind.
VI. The Reſult of a Calculation made on the obſtructed WATER, occaſioned by the great Bulk of the old PILLARS, and the Advantage gained by rebuilding the Bridge according to any one of theſe Deſigns.
VII. Of MODELS and their appendant Machines, neceſſary for building this Bridge, according to the 1ſt, 2d, and 3d Deſign.

AS ALSO

A ſhort Deſcription of the Method and Size of
the Materials (propos'd) to be uſed in the
Courſe of this Work.

By *JAMES BRIDGES*, ARCHITECT.

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- - - - Much more in this great Work,

- - - - - - ſhould we ſurvey
The Plot of Situation, and the Model;
Conſent upon a ſure Foundation,
Queſtion Surveyors, know our own Eſtate,
How able ſuch a Work to undergo,
To weigh againſt his Oppoſite? Or elſe,
We fortify in Paper, and in Figures,
Uſing the Names of Men inſtead of Men:
Like one that draws the Model of a Houſe
Beyond his Pow'r to build it; who, half through,
Gives o'er, and leaves his Part-created Coſt
A naked Subject to the weeping Clouds,
And waſte, for churliſh Winter's Tyranny.

SHAKES.

BRISTOL:
Printed by E. WARD, oppoſite the POST OFFICE, 1760.

G.R III.
BRITISH MUSEUM

Four Deſigns for Rebuilding BRISTOL BRIDGE.

Humbly inſcrib'd to the Gentlemen Commiſſioners.

GENTLEMEN,

PUBLICK Good and Publick Spirit having at laſt got the better of private intereſt, you are now become a Committee authorized and appointed by parliament, made up of perſons every way qualified for ſo great a truſt, who are to preſide over the execution of this moſt uſeful and moſt neceſſary work.

The publick may therefore very ſafely rely on your judgment and deciſion, in an affair in which you ſeem prepared to act with the moſt wary caution; and that without any buſy body writing or ſpeaking againſt either the ſteps you may take, or againſt any of the deſigns now offered to your conſideration; as none but yourſelves can have ſufficient time and opportunity to examine them with that attention the thing itſelf requires: Attempts of this nature can therefore only be looked upon as ill-timed and inſignificant endeavours to diſturb or bias your ſentiments, and tend to reflect the higheſt affront upon a reſpectable body of gentlemen, who have reſolved for a publick benefit to prefer true merit only.

A noble reſolution, and more ſo at a juncture when few artiſts have any hopes of ſeeing men of abilities precede thoſe of *impoſture* and *intereſt*, which diſcourages many from applying their thoughts for the ſervice of the publick.

It is from this motive, and from ſuch views of future reputation and intereſt as may be admitted (I hope) without prejudice to one of my profeſſion, to lay before you my thoughts on a ſubject of an abſtracted, difficult, and unuſual nature, being ſuch as probably will not offer again for ages to come.

You are at laſt arrived at that criſis, wherein by your determination you are to do honour to yourſelves and your country, for a long ſeries of years, by erecting a ſtrong, uſeful, and magnificent ſtone bridge, with noble avenues, or, to forfeit your own reputations, bring a reflection upon your age and country, and render yourſelves juſtly blameable in the eyes of poſterity, by leaving them a weak, inconvenient, or mean one.

Before I ſay any thing of what is now offer'd either by myſelf or others, it is neceſſary to inveſtigate what it is that is wanted; for when a rule or ſtandard is made, you may then apply each of our ſchemes, to ſee how it deviates more or leſs on one ſide or the other: and you, *Gentlemen*, who have but ſhort time for the conſideration of this main point, may the better judge with perſpicuity and preciſion, when the whole is ſummed up.

It is required to build a bridge acroſs the *Avon*, on a new, or on the old foundation, which ever may appear the moſt eligible, by what is meant the eaſieſt paſſages for men and carriages along ſuch bridge from *Redcliff* ſide down to the Back and up *High-ſtreet*, and the ſame convenience for ſuch craft as navigate the *Avon* under it. The beſt paſſage for the firſt would be a ſtraight line from the top of one bank to the top of the other; and the beſt for the ſecond would be, that this line ſhould be elevated ſo high as to make it as little troubleſome in paſſing under and over it as poſſible; having, at the ſame time, a ſtrict regard to leſſen the ſteep aſcent up *High-ſtreet*, while you do not too much increaſe the deſcent going down to the Back.

The beſt bridge for utility, therefore, will be that which ſtrikes a juſt medium between theſe two extraordinary oppoſites

When a weſterly wind blows hard, and a ſpring-tide is at its greateſt height, with freſhes from the land, then the ſurface of the river *Avon*, at the bridge, buries the old arches 16 inches, and overflows its banks to the entrance of *Baldwin-ſtreet*: at that point of time, men and carriages are to paſs along the bridge, and craft are to paſs under it; the firſt is very practicable, but the ſecond impoſſible, unleſs the middle of the bridge is made a mountain; therefore the crown of the center arch muſt be ſo regulated as to be above the higheſt high-water mark, without making the paſſage over the bridge of too difficult acceſs. From what the maſters of barges and lightermen ſay, I find they cannot paſs through the preſent arches (being gothic, or peaked) till the ſecond quarter of ebb. I apprehend the moſt that can be done in this caſe, will be to give them free paſſage at the firſt quarter ebb, which will be the greateſt improvement to the navigation it can receive, while you do not too much increaſe the difficulty of the paſſage over the bridge, and in ſome degree leſſen the aſcent into *High-ſtreet*, &c.

Having fixed this imaginary line, as what I humbly think a juſt medium between going over ſuch a bridge, and navigating on the river under it; the next requiſite is to ſupport it; and to do it in ſuch a manner, that the piers and arches ſhall as little as poſſible obſtruct the flux and reflux of the river, and boats and barges moving on it. This end alone would be beſt anſwered by having none at all; or if any, the moſt ſlender ones; but ſtrength and duration muſt be alſo conſulted. *Great care muſt be taken, that the ebbing tide and freſhes do not too much diſturb the veſſels lying at the Back and Slips.*

Each of theſe main articles I have made my principal ſtudy in planning theſe deſigns, as well as my judgment will allow, to ſet it and every other particular in as clear a point of view as poſſible. It is a more intricate piece of buſineſs than moſt people are aware of; and if I ſhould fail in any particular, I make no doubt, for the benefit of this community, you will add what may be found good, to that ſuggeſted by your own ſuperior judgements, or what may be collected for your uſe by ſome more able hand.

I.

A New BRIDGE, *conſiſting of three ſemicircular arches, ſuppoſing the ſame to be erected on the old foundation.* *

DIviding the water properly is a very eſſential part to be conſidered. The main body of the river muſt be allowed to keep its natural courſe, and the center arch to give it free paſſage: but it muſt be obſerved alſo, that wherever there is a violent force in the body of a ſtream (as is the caſe in this river) there is a rippling current at the ſides, which is conſidered in the conſtruction of this deſign, whereby the main body of the water, with its utmoſt rapidity, will pour almoſt uninterruptedly through the great or middle arch, whilſt the ſide-currents paſs in the ſame manner through the extreme arches; becauſe the ſide-

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* *Explanation of this Deſign.*

A	The elevation of the weſt front of Briſtol Bridge.
B B	The plan of the foundation and ſuperſtructure.
C	The geometrical elevation of the temporary bridge, erected on ſtone piers, for the greater ſecurity againſt accidents.

currents will be divided from the main one by the piers, and this with little moleſtation or interruption, as the main body will receive but little change. *This change* is entirely owing to the poſition of this new bridge on the old foundation, which cauſes the ſtreams (both flood and ebb) to paſs through the arches with a ſenſible obliquity; or otherwiſe, let the river be high or low, rapid or ſmooth, it would be carried with eaſe through thoſe arches, whoſe proportions, as confined to the old foundation, are thus determined, *viz.* Center arch 45 feet diameter, and that of the two ſide arches 37, and their piers 9 feet: Here the piers are full ſtrong enough, not only to ſupport all *weights* that may come over the *bridge*, but will alſo reſiſt the torrents of water from the greateſt floods, and at the ſame time will not too much interrupt the courſe of the *river*, as the old piers now do, they being nearly equal to their openings: So that the three new arches will have 20 feet 6 inches more water way than the preſent four arches, (as will be made more fully to appear) and the whole quantity of the ſide-currents being thus taken off, the great body of the water will roll through the center arch, with all that freedom it ought to do, the obliquity of the ſtreams (as before obſerv'd) excepted: and at the ſame time the ebbing tides or freſhes will diſturb the veſſels lying at the *Back* and Slips, but in a ſmall degree.

The quantity of ſtone, and its weight, contained in this deſign, is very great. But to reduce this quantity, to make the bridge equally as ſtrong (or rather ſtronger) and yet preſerve the ſame ſymmetry, is my next endeavour; which will bemade very plainly to appear, by a plan and ſection of the bridge, ſhewing at one view the nature of making chain-courſes, in-ſide ſpandrels, and drains, alſo the different materials, their diſpoſitions, and connections they have to one another, *&c.*

All kinds of regular arches being equally preſſed, will ſuſtain the greateſt weights; but if one ſide of a regular arch be preſſed much more than the others, (which is always the caſe, when arches differ ſo much in ſize as theſe do) the curve in time will ſooner change its form, become rampart, and fall down; as was the fate of a large ſtone bridge, about the year 1710, built upon this principle over the river *Allier*, at the town of *Moulins*, in *Provence*, in *France*, called the *Bourbonois*.

Now to prevent this unequal preſſure, as well as to abate the great thruſt of the arches againſt their own abutments, as alſo to leſſen the weight on the old foundation, I propoſe a *concave horizontal cylinder* in each ſpandrel, each pier, and in each abutment, which are repreſented by the dotted circles in the drawing, Fig. I. to be continued quite through the whole thickneſs of the bridge, the out walls only excepted; by means of which the weight of each ſpandrel will not only be greatly

abated,

abated, but by making the cylinders in the upper ſpandrels proportionably larger than the cylinders in the lower ſpandrels, their preſſures will be equal; and therefore not only free from the danger of the unequal preſſure aforeſaid, but will be a ſaving of materials and money to the amount of near 200 *l.* and the bridge made ſtronger; as Fig. II. fully explains,

A *The timber grating, or bottom of the caiſſons.*

B *The piers built ſolid with* Felton *and* Bath *ſtone.*

C *The ſemicircular, or outer arch of* Felton *ſtone.*

D *The counter arches of* Dundry *ſtone, formed thin or light at the key ſtones, and broader or heavier at their ſpringings; ſo as to reſiſt the thruſt, rnd ſerve as abutments to the ſemicircular arches under them. The backs of thoſe counter arches are covered with paving ſtone, laid in Elias lime, to prevent the rain water, and filth, which may ſink through the Pennant paving, from running into the joints of the arches, alſo to convey it to the drains prepared for it.*

E *The concave horizontal cylinders, turned with up-river ſtone.*

F *The drains running the whole length of each pier, higheſt at each end, and made of up-river ſtone laid in terras, to convey the water and filth through ſtone pipes, out at the ſoffet of the arch.*

G *The inſide ſpandrel walls built with up-river ſtone laid in courſes* 4 *feet thick at bottom, and* 2 *feet at top.*

H *Pitching or Pennant covering for the road.*

Fig. III. A plan of the ſame piers and arches, ſhewing, *the ſpandrel walls* G, *the croſs walls or chain courſes* H, *the concave horizontal cylinders* E, *and the ſpaces between them* W, *filled with up-river ſtone laid in mortar and random courſes.*

II.

Three Eliptical Arches on the Old Foundation, calculated to ſave Expence †.

THE height and diameters of thoſe arches are in all reſpects anſwerable to the ſemicircular before-mentioned, and have the following good reaſons in their favour: *firſt*, Saving a quantity of maſonry: *ſecondly*, Contain more variety in their figure: *thirdly*, Will give on extraordinary tides more water way: *fourthly* and *laſtly*, The fineſt bridges in *France* have elliptical arches; I mean the *Pont Royal* at *Paris*, and that at *Blois* over the *Loire*.

That they ſave a great quantity of materials is evident, becauſe they are reduced in the ſame proportion as the radius of the arch is to its height; that is, if the radius be 22 feet 6 inches, and riſe 16 feet 10 1-half, that is 3-4ths of the radius merely, the quantity of the maſonry is likewiſe reduced to the ſame proportion; as is more particularly explained by the following methods, *viz.*

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† *Explanation of this Deſign.*

A The geometrical elevation of the weſt front of Briſtol Bridge.

B B The plan of the foundation and ſuperſtructure.

Area of the face of the ſuperfices from the cornice to the ſpring of a ſemicircular arch, whoſe width is 45 feet, and 5 feet of maſonry above it to the under ſide of the cornice, that is 45 by 27 feet 6 inches	1237	50
Area of the ſemicircle	794	51
Area of the face of the ſolid	442	99
Area of the face of the ſuperfices from the cornice to the ſpring of an elliptical arch on the tranſverſe diameter, whoſe width is 45 feet, altitude 16 feet 10 1-half inches, and 5 feet of maſonry above it, to the under ſide of the cornice, that is 45 by 21 feet 10 1-half inches	984	15
Area of the ſemilliptic arch	596	34
Area of the face of the ſolid	387	81
Difference of the area of the ſolid	55	18
Difference multiplied by the admitted width of the bridge, viz. 44 feet, gives cubed feet	2427	92

Cube of ſolid ſtone work to the ſemicircular arch	19491	56
Ditto of the ſemi-elliptic arch	17063	64
Difference in the ſolids as before	2427	92
Two 37 feet arches in the ſame proportion	3991	22
Total ſav'd in cubical feet	6419	14

A plain proof of the advantage elliptic arches have over ſemicircular ones, in the article of ſaving, tho' in my opinion they are not ſo ſtrong, (even with the aſſiſtance of a counter arch and joggle joints) yet ſtrong enough for arches of ſo ſmall a ſpand. This deſign may alſo have the advantage of the concave horizontal cylinders, in the piers and abutments, but not in the ſpandrels.

It muſt be obſerved, that the center arch of theſe two deſigns will be 3 feet higher than the preſent arches, and 1 foot 8 inches higher than the greateſt tides ever known. But notwithſtanding this lofty elevation, the two ſide arches will on the higheſt ſpring tides be buried 2 feet 4 inches: a very ugly circumſtance, not to be avoided, unleſs by running into a worſe extreme, *viz.* raiſing the pent of the bridge; which would not only make it too laborious (as a trading city) but would alſo require a much larger quantity of forced earth on the banks; as will more fully appear by a plan and ſection of the river, arches, and ſtreets, annexed to theſe deſigns.

III.

A Deſign of five Segment Arches to ſpand the whole Breadth of the River, on a new Foundation ‡.

THIS deſign conſiſts of five arches, the center arch is 40 feet wide, its piers 1-5th of the opening; the adjoining arches are 32 feet wide, and the two extreme arches 21 feet 9 inches, (a very agreeable gradation.) Theſe arches have their piers and height of arches, in the ſame proportion as the center opening: the arches ſpring from lofty ruſticated piers, with blocked architroves. Theſe butments require to be 27 feet, as on them depend the whole ſeries of arches, (for their ſupport) the bottom of the piers are 1-3d more than the naked above, and gradually ſet off by each bed of ſtone. The block keys that conſtruct the archivolt, are as 1 to 14 of each arch's diameter. The finiſhed ſatium and block cornice, 2 feet 3 inches above the key. Parapet wall 3 feet 3 inches: and the plinth die of the pedeſtal and rail 3 feet high, with globular balls, on which may finiſh iron ſtandards for lamps (if required.) In ſhort, the compoſition of this deſign, without enquiring into the mechaniſm of it, is truly magnificent; though ſimple, light, yet not too ſlender; and modeſt, without bordering on ruſticity. It may be further ornamented in the ſpandrels by niches, The cornice along the bridge is grand and ſtriking; the pedeſtals and balluſtrades running from one end of the bridge to the other, (when viewed from the new-made ſtreet, and the Back) is very ſimple, and gives a great ornament to the whole ſtructure. This bridge being built on a new foundation, will bring St. *Thomas-ſtreet* and *High-ſtreet* nearly in a ſtraight line.

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‡ *Explanation of this Deſign.*

A A A A A A The piers and abutments from which the arches ſpring.
B The elevation of the weſt front (on a larger ſcale.)
C C The intended houſes at each end of the bridge.
D D The piers belonging to the temporary bridge.
E The pillar belonging to the old bridge.
F The geometrical elevation of the temporary bridge.
G The ſection of the temporary bridge (on a larger ſcale.
H The conduit.
I St. Nicholas Church.
K St. Nicholas Gate.
L The new gate for carriages.
M The new gate for foot paſſengers.

N. B. The dotted lines in the ſtreets denote the front of the houſes as they now ſtand; and the dark lines ſhaded, as they are intended to be built; which brings the middle of St. Thomas and High Street nearly in a line with the center of this new bridge, as appears by the dotted line L L.

There is nothing can ſet this deſign aſide, unleſs 'tis the articles of expence, and the time that will attend the laying of theſe new foundations; becauſe recourſe muſt be had to piling, as the journal of the borings will demonſtrate, which is as follows:

St. *Nicholas Side.*

6 feet mud, looſe gravel, and oyſter ſhells.
3 do. ſtiff blue clay.
3 1-half do. looſe ſand mixed with water.
2 do. looſe dry ſand.
4 1-half do. red ſtiff clay mixed with ſmall white ſtones, and then come to a firm ſandy rock, after boring in the whole 19 feet.
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19

Redcliff Side.

7 feet mixed ſand, mud, and looſe gravel.
2 do. looſe ſand.
2 1-half do. flexible clay mixed with ſmall looſe ſtones.
4 do. without ſtones.
4 do. ſtiffer clay of a blue caſt.
4 1-half do. red ſtiff clay, and come to a firm ſandy rock, after boring 24 feet in the whole.
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24

Hence it appears, that piling is abſolutely neceſſary. For it muſt be particularly obſerved and attended to, that whenever a ſtone pier is built on a bed of clay, or any other yielding body, under which is a ſtratum of leſs conſiſtency, as of mud, looſe ſand mixed with water, &c. the weight of the bridge preſſing on the clay, will cauſe the clay to preſs in its turn on the infirm ſtratum beneath it in a perpendicular direction, and when the infirm ſtratum, on which it bears, retorts with a force equal to the perpendicular preſure, then the liquid parts of ſuch ſtratum, are compelled thereby to act laterally in a horizontal direction.

As to what time, the preſs'd water in the interſtices of an infirm ſtratum, takes to vent itſelf through the pores of the clay, is according to the force of the weight impreſs'd, and to the texture and thickneſs of the ſtratum; thus it is, that a bridge built on ſuch a foundation, may ſtand for ſome conſiderable time, whilſt the impreſs'd water contained in the interſtices of the infirm ſtratum is making its way upwards thro' the ground, but muſt ſooner or later ſink at once into unavoidable ruin, as was truly the caſe of the fifth pier of the grand bridge from *Weſtminſter* ſhore. Therefore, to ſecure a proper foundation for this ſuperſtructure, recourſe (as obſerv'd before) muſt be had to piling, (and tho' a favourite ſcheme) yet I muſt acknowledge that the piling will be attended with ſome difficulty, time, and expence; but not quite ſo great an expence, as perhaps, may at firſt thought be imagined: Therefore, to make the article of piling truly intelligable, I ſhall firſt ſhew the expence of piling of one pier; and then, by comparing its area with the reſt, and their abuttments, the whole expence may be nearly known.

As *Narva* and *Riga* fir-timber, is undoubtedly good and as durable as oak, for piles driven, to be always under water: I ſhall therefore conſider the piles in general, to be of ſuch timber, that they be 20 feet long, and 12 inches ſquare at a mean, from end to end, which therefore,

will

will contain 20 cubical feet, value 30 *s.* to which add, for its iron-hoop, ſhoe and nails, 12 *s.* for hooping, ſhoeing and driving, 8 *s.* (excluſive of the uſe of the machine) which I will allow 5 *s.* more; therefore, the ultimate expence, per pile, when drove, will not honeſtly and fairly exceed the following ſum, *viz.*

	l.	*s.*	*d.*
20 cube feet of *Riga* timber . .	1	10	0
Iron-hoop and ſhoe, weight 52 *lb.* at 3*d.* per *lb.*	0	13	0
Workmens labour, to hoop, ſhoe and drive	0	12	0
Uſe of the machine, *&c.*	0	5	0
Total per pile	£ 3	0	0

The next thing to be conſidered, is the magnitude of the baſe of the pier, covered by the lowermoſt ſtone plinth, is about 986 ſuperficial feet.

To ſecurely pile the foundation of a pier, its limits at a ſmall diſtance round it, ſhould be firſt encloſed, with a range of piles drove cloſe together, to confine the ground over where the pier is to be erected from dilating, by the lateral force of the internal piles, when driven into it.

The number of piles ſo required, to bound the limits of this pier, is about 180, which will diminiſh the area of the baſement as many ſuperficial feet; and the area of the incloſed ſurface, will then be but 806 feet.

Now, if into every 4 ſquare feet thereof, be driven a pile of 12 inches ſquare, then every cube foot of ground, for 20 feet in depth, will be forced or compreſſed into three-fourths of its natural ſpace; and conſequently, will be one-fourth more compact than before, whereby it will be made more than capable to ſuſtain its weight. Now, if 806 feet, the area of the aforeſaid incloſed ſurface, be divided by 4, the quotient 201, is the number of piles neceſſary to pile the ſurface of one pier with ſecurity; which, together with the 180 bounding piles, makes 381 in the whole: Now, 381, multiplied by 6, the number of piers with their abuttments, makes 2286 piles, a number full ſufficient for the whole bridge; which number multiplied by the ſum or coſt of each pile, *viz.* 3 *l.* makes the ſum total, 6858 *l.*

I have now ſhewn the greateſt expence that will attend the piling of all the piers and abuttments of this noble ſuperſtructure.

IV.

A Deſign of an Arch 130 *feet Cord, and Altitude* 29.

THERE are many good and excellent reaſons, for building a bridge of a ſingle arch, as the conſtruction of ſuch a bridge is not limited to any particular extent; though

the

the eye of reaſon will eaſily diſtinguiſh where-ever it is carried to an extreme, *&c.*

The advantages are very great; the common accidents which ruins many bridges, will have no power over this; for one fabric of this kind, that is devoured by the hungary teeth of time, many of the other are torn, or thrown down by torrents, from land-floods, loads of ice, floating timber, and loaded veſſels, which the ſwelling of the waters frequently bring down with them, with ſuch irreſiſtable impetuoſity againſt the piers, that they are often undermined thereby, which naturally occaſions ſettlements, *&c.*

Beſides, there are many bridges of the former conſtruction, that is an annual charge, (*Briſtol* bridge is not exempt) and, wherever the extent is not beyond all reaſonable propoſal for a ſingle arch, that ſhould be the method of avoiding it, if double the expence were laid out thereon, it would be in the end frugality; but, indeed, ſkill is required more than price in ſuch a fabric, though both of theſe articles will in this caſe be leſſened, becauſe, the *piers* of the old arches may remain to ſupport the center, and leave the navigation free during the execution of the work. *This lucky Article only, will be a means of ſaving much time, and ſome money to the public.*

In ſhort, no bridge is more beautiful than one of a ſingle arch, none more convenient; beſides, the numerous accidents which are avoided, from which ſecurity, there reſults a

promiſe

promiſe of great duration; and none are ſtronger, when made with proper buttments, and proper arch-ſtones.

But, as this grand *arch* borders ſo near to the width of that deſign'd for *Hawkin*'s-*Lane*, and has been ſo much the topic of converſation, and ſuch a number of advocates for turning a large *arch*, with up-river ſtone, I ſhall dwell the longer on this article of *ſtone* on that account, as it appears to me a matter of the utmoſt importance, with reſpect to the ſafety, as well as the reputation of my fellow-citizens; therefore, I cannot help contributing my thoughts, in doing which, I ſhall be careful to offer nothing but what is the reſult of ſeveral years experience and ſtudy.

It hath ever been the opinion of all able and judicious architects, grounded upon experimental, as well as theoretical knowledge; that LARGE ARCHES, built with ſmall ſtones, is the moſt exceptionable of all arches; as they are extremely weak, and alſo void of beauty: *The great queſtion is, therefore, whether* an ARCH *built with large or ſmall ſtones is to be preferr'd.*

The firſt excellence of a bridge, built for commerce, over a large and rapid river, like the *Avon*, is ſtrength; for a bridge which cannot ſtand, however beautiful, will boaſt its beauty but a ſhort time: The ſtronger therefore the arch is, that, and that only ſhould be preferable; and, ſo much the more to be prefer'd, *that if*, with greater ſtrength, it has at the ſame time a greater beauty.

Thoſe who are acquainted with the mathematical principles of architecture, are not many; and yet, fewer are they, who will upon any ſingle occaſion, endure any laborious ſtretch of thought, *&c.*

I ſhall now attempt to ſhew the weakneſs of this vaſt extended arch, built with ſmall ſtones, by arguments which appear ſimply to common reaſon, and will ſtand the teſt of geometrical examination.

All arches have a certain degree of weakneſs, no hollow building can be equally ſtrong with a ſolid maſs, of which every upper part preſſes perpendicularly upon the lower; any weight laid upon the top of an arch, has a tendency to force that top into the vacuity below; and, the arch thus loaded on the top, ſtands only, becauſe the ſtones that form it, being wider in the upper than the lower parts; for, that part which fills a wider ſpace, cannot fall through a ſpace leſs wide, but the force which laid upon a flat would preſs directly downward, is in this caſe diſperſed each way, in a lateral direction, in proportion as the ſtones are wider at the top than at the bottom, they can leſs eaſily be forced downwards; and, as their lateral ſurfaces tend more from the center to each ſide, to ſo much more is the preſſure directed laterally towards the buttments, and conſeqnently, ſo much leſs perpendicularly towards the vacuity.

Upon this plain principle, the large ſtones may be demonſtrated to excell in ſtrength and beauty, the ſmall ones; for, it is evident, that arches of ſuch a vaſt ſpand, built with ſmall ſtones, will make no key, or have no ſommering, as workmen term it: That is, the backs of the arch ſtones will ſo little exceed the under ſides of them, that they will have no wedge-like form to hang by, on which depends the ſtability of all arches; beſides, there is a fundamental law in architecture, never to be violated, eſpecially, as it is entirely framed on the eſtabliſh'd laws of ſtrength, *viz. As all arches increaſe in diameter, ſo ſhould the arch ſtones increaſe in length and thickneſs, in a certain geometrical proportion*; as may be ſeen at firſt ſight, by inſpecting into Mr. *Gautier*'s Table of Vouſſoirs, (which I have now before me.) Alſo, in the Memoirs of the Academy of Sciences, there is an article, which teaches how to compute the lateral preſſure of an arch, and to proportion the archivolt to its diameter, in order the better to regulate the ſtrength required in the abuttments to reſiſt it, and to ſave the unneceſſary expence of labour and materials.

From what has been ſaid, I belive it may be fairly concluded, (beyond all contradiction) that large ſtones is the ſtrongeſt and moſt beautiful; and, that ſmall ſtones are weak, defective in beauty and ſafety; what then, can influence any one to be an advocate for the latter, in preferance to the former? Is it hardy *ignorance*, *novelty*, or for oppoſition *ſake?* Surely, no reaſonable man would try dangerous practices for ſuch idle fancies: Here then, on the one ſide is *ſtrength*, *beauty*, *convenience* and *certainty*; on the other, *weakneſs*, *deformity* and *doubt*. Is it reaſonable then, to make choice of up-river ſtones and reject large materials? I know but of one pretence that can bear the colour of reaſon, and that is, the bridge in *Wales*, over the river *Taaff*, in *Glamorganſhire*; a monument to the memory of the builders, who wiſely calculated the fabric, to its ſituation and uſe, *viz*. for horſemen and foot paſſengers: On the contrary, this ſingle arch is deſign'd for the center of a large mercantile city; therefore, a calculation of what it is to bear, muſt be made on the extreme, and not from the common courſe of things, or known weight of carriages; but, like a proof of cannon with a double charge. Accidents may occaſionally bring upon it a much greater weight then is at firſt thought of; or, perhaps its fabric may from ſome unforeſeen cauſe, be leſs ſolid then imagin'd: It is therefore beſt to err on the ſide of too much ſtrength.

To anſwer this great end, and make the bridge yet more complete.

It may not be amiſs, (and I hope, not ill receiv'd) to premiſe a word or two by way of caution.

I doubt not, but there will be ſeveral competitors for the honour of building this bridge; it may therefore be neceſſary to hint, that he who enters the liſt, muſt not leave one ſingle article unconſidered, ſo far as it regards his plans, his materials, and method of uſing them. To build this bridge, is *one thing*, and to do it *well* is *another* ; there is certainly a point of perfection to be arrived at. It is the fate of architecture, that there are ſuch preciſe rules for conveying ideas in this art, that any one may copy and produce pieces of it at pleaſure, at the ſame time that they have not had opportunity by ſtudy and education to know when theſe parts are moſt applicable to particular caſes. Neither will that man ever execute his deſign well, which he contrives by piece-meals ; all muſt be planed together, and every part regulated upon a juſt idea of the whole, (which here admits of great variety)

By ſuch a conduct, all will end well, he will raiſe his own reputation, while he adds honour to the Commiſſioners ; and leaves a laſting monument of the wiſdom and zeal of the citizens of *Briſtol* : Nay, his work cannot fail of being *graceful* and *commodious*, there being a law in *architecture* (handed down from father to ſon) that the article of *gracefulneſs* always depends upon proper *ſtrength*, joined to a proper *proportion* the different parts have ; *firſt*, in themſelves ; *ſecondly*, to one another ; and, *thirdly*, to the whole *fabric* ; in ſhort, there is nothing ſo much that ſhews the compleat builder, as having every part of his plan in his thoughts, before any portion of it is reduced to execution. It was by this, the goodneſs of *work*, and the choice of *materials*, the *Builders* of *old times* made themſelves ſo *famous* ; how far I have ſtudied implicitly the antient, in this particular, will be beſt ſeen in my deſigns ; thus much

I will venture to ſay, that it has taught me ſome fore-ſight, which, may not perhaps be altogether unworthy of notice, *viz.*

Should the *ſingle arch* obtain the prize from all the deſigns now offered, and you ſhould think another bridge abſolutely neceſſary at *Counter-Slip,* it may be ſo contrived, that the ſame CENTER that is uſed for building *Briſtol* bridge, would become quite uſeful to ſuch a bridge; and that, without the leaſt alteration. A bridge ſo ſituated, may prove a means of accommodating a great number of our fellow-citizens, at a moderate expence. Two *arches* ſo open to navigation, and ſo elevated out of ſight of each other, with the veſſels paſſing too and through, will afford a view quite agreeable to a merchantile city. To look at thoſe ſtupendious *arches* (at a certain diſtance) will rather have the appearance of an artificial rainbow, than a real bridge. In ſummer too, the coolneſs of the air muſt be highly pleaſing and refreſhing; while the eye of ſedate contemplation take in the more diſtant objects, the air too will be rather better than can be found in any of our ſtreets or ſquares, *Bullocks-Park* excepted *.

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* BULLOCKS-PARK, is now laid out for building, with a noble ſtreet 60 feet wide, already prepared with good drains; fine reſervoirs, ſupplied with excellent ſpring water; and ſuch other conveniencies as to render it (by far) the beſt ſtreet in Briſtol. Its delightful ſituation is on a gentel declivity, that furniſhes you with a proſpect of the city

This deſign is drawn at large, and the explanation of the center *for this great* arch *is as follows; alſo, how the three ſemicircular* arches *take their ſpring from the old foundation,* &c.

The *arch* while building, is ſuppoſed to be ſuſtained by this *center*, conſtructed upon principles, anſwering the various purpoſes intended; by ſupporting with certainty, the vaſt incumbent weight; Alſo, to avoid even the leaſt concuſſion in taking it away, and giving of itſelf, in ſuch its removal-ſtages, in nature of ſcaffolds; for the better tooming and pointing the ſoffeit of the arch, and during the whole work will admit of free navigation, though the cord-line ſubtending the ſegment of the circle is 130 feet, the depth of the arch from Eaſt to Weſt, is 44 feet. The whole *center* to be compoſed of 9 ribbs or frames, one of which is accurately expreſs'd by the drawing E. ſtanding on the old pillars, and will ſupport 3620 tun weight, before it can be relieved by keying in.

The plates, upright-poſt, circular-timbers, king-poſt, braces, and bridgings, are all of fir-timber, 12 by 13 inches, except the king-poſt, and bridgings; the king-poſt to be 12

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city and country at the ſame time is highly pleaſing. This ſtreet lays healthy and dry in the greateſt rains, without being too much elevated, or expoſed to the winds: The entrance is from College Green, and will be continued in a line till it meets a new turnpike-road, that leads to that healthy and much-improv'd village of Red-Land, &c.

by 18 at top; the bridgings 9 by 15, and about 12 inches aſunder. This *center*, is in all reſpects contrived for the preſervation of the old as well as the new-works; and, for protecting the ſame againſt the river-craft, tide-waters, freſhes, floating-timbers, and ice: In ſhort, againſt every ſuppoſable fatality, in a ſituation ſo ſingular and dangerous, A A A A, or dotted ſweeps, are the four old *Gothic* arches. B B B. The three ſemi-circular arches, reſting on the old foundations under water. C C. the great *Arch*, taking its ſpring from the old foundation, at the North-end; and, on part of a new foundation, well piled at the South-end *. X O, middle of the *One-Arch* bridge. X O O, middle of the old bridge. X O O O, middle of the *Three-Arch* bridge. D, an old *Gothic-Arch*, to be ſtopt quite up. E, the navigable *Arch*, during the whole time of re-building the bridge.

V.

The Properties of the different Quary-Stones, uſed in England; *and, which are moſt proper for a Work of this Kind,* &c.

THE firſt ſort that is of note, and not apt to ſplit, is ſuch as lie in thick compact maſſes, and are of four ſpecies, *viz.* Iſt. *Portland*;

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* But this end of the *Arch* may alſo take its ſpring from the old foundation, by ſubtending the cord-line, about 10 feet, which will not only be making the bridge more ſecure, but will alſo admit of 10 feet more watering-way; and in my opinion, I think, it will be a very conſiderable improvement to this deſign.

land; IId. *Purbec*; IIId. *Bath*; and IVth. *Ryegate*; of theſe four kinds of quarry-ſtones, the *Portland* is the beſt; *Purbec*, is alſo an excellent ſtone for many purpoſes; the *Bath* ſtone does very well for aſhler, (above ground,) but not ſo well in water; *Ryegate* ſtone (is commonly called fire-ſtone) it works very eaſily, and is inferior to the *Bath* in its durability and ſtrength. Theſe are the principal kinds of quarry-ſtone, which are of moſt note amongſt us; But, beſides theſe, there are ſeveral kinds dug and uſed in different countries; they have a fine white Free-ſtone in *Dorſetſhire*, but its fault is being brittle; in *Northamptonſhire*, they have a greyiſh kind, but, brittle alſo. There is likewiſe, a browniſh kind, that cuts very freely, common in many of our northern counties: In *Yorkſhire*, they have a greyiſh kind, that is full of little ſpangles; and, in *Suſſex and Glouceſterſhire*, there is a brown ſort, (extremely hard) that glitters in the ſame manner. Theſe, are all of them uſed in the ſeveral places where they are produced; but, none in *England* comes ſo near the *Portland*, as the *Felton* and *Dundry* ſtone, (about five miles diſtant from *Briſtol*, in *Somerſetſhire*) nor none is ſo reaſonable and ſo fit for a work of this nature. I made a journey to the quarries, procured a ſtone from each, and had it work'd-up as true as poſſible, with a piece of *Portland* ſtone of the ſame dimenſion, and all were equally dry; their qualities appeared as near in every reſpect, as does their ſpecific gravities.

The *Felton*-ſtone raiſes from half a tun to three or four tuns, but the *Dundry* not ſo large, and may be brought here much cheaper than the *Portland*: Stones that work eaſily, are not fit for our purpoſe, becauſe they decay the ſooneſt; the ſame looſe texture that makes them work ſo freely, renders them unable to bear the aſſaults of the weather. The air is a kind of univerſal diſſolvent, we often ſee in old buildings what effect it has upon the outſide ſtones, eſpecially on thoſe uſed in ornamental parts.

There is a bridge now ſtanding, nearly of the ſame dimenſions of my firſt deſign, built over the *Rezoone*, that has ſtood upwards of 2000 years, and we may well admire its ſtructure; but, thoſe who would have their works of the ſame kind, laſt a like period, muſt more than admire: They muſt underſtand its conſtruction; for, it is not only good materials, but the truth of work, has kept the whole together ſo many years.

I would therefore particularly recommend, (whatever ſcheme takes place) what is now ſo much neglected, and what the antients ſo much ſtudied; that is, I would have the ſtones cut into large blocks, (without flaw or blemiſh) and, however rough or unornamented the exterior parts of the bridge may be, particular care ought to be taken that the ſides ſhould join together with the greateſt nicety and truth.

The mortar ſhould be ſaid to be tempered from the labourers ſweat, as no toil, no time ought to be ſpared to blend its parts together.

Thus, ſhould the materials be prepared, and put together with equal labour, no art, to be omitted in connecting and uniting them; with this accuracy and induſtry, I would engage to form the whole ſo firm, as if the bridge had been cut out of one huge maſs.

Beſide the *Vouſſoirs*, or *Arch* ſtones, in each front, could then have proper *Chamfer'd Joints*, which may be continued quite through, under the ſoffeit of the arches; becauſe, experience ſhews this ruſtic decoration of the *archivolt* of the arches, to have a very good effect, (in large work on the water eſpecially) and the chamfering the joints, hinders the fluſhing, or breaking of the edges of the ſtones.

With ſuch workmanſhip and ſuch materials, *Briſtol* bridge, for *ſtrength*, *beauty* and *utility*, would not be inferior to any the antients ever boaſted of: But, alaſs! in this part of *Great-Britain*, there has not yet appeared that patronage among the great, or ſpirit in the public.

Therefore, Gentlemen, if you have hopes for the admiration and eſteem of poſterity, look to theſe things in time; as too much care cannot be taken to prevent confuſion in the firſt ſetting out, there being no method that can be taken to rectify the error afterwards.

VI.

The Reſult of a Calculation made on the obſtructed water, occaſioned by the great Bulk of the Old Piers; and the Advantages gain'd by rebuilding the Bridge according to any one of theſe Deſigns.

MANY has wondered, and many are ſtill doubtful whether the three *arches* thus erected on the old foundation, will admit of ſo much water-way as the preſent four *arches*.

It appears by a meaſurement taken at *Briſtol* bridge, that the breadth is 185 feet, depth in the channel, at the higheſt ſpring-tide, 28 feet, and at low-water 5 feet, the mean depth of which is 16 feet and a half.

If 185, the breadth, be multiplied by 16 and a half feet, the product will be 3052 feet 5-16ths, which is the number of cubical feet of water, advancing at ſuch times forwards, by the velocity of the current.

If by impediment, any of theſe 3052. 5-16ths cubical feet of the water be obſtructed in their natural courſe, the feet ſo obſtructed, will raiſe themſelves upon the ſurface of the water whoſe courſe is free; for, as there is a conſtant ſucceſſion of water, the obſtructed water muſt paſs away over the free water, in the ſame time.

On *Friday*, the ſecond of *March*, 1759, by order of the *Committee*, I obſerv'd, that the obſtructed-water, raiſed upon the free-water (at half ebb) when it paſs'd by the impediments, made a fall of about 16 inches, which is a great increaſe, particularly to the velocity of the ebbing-tide, and much greater at firſt, quarter of ebb, (owing to the form of the arches, which are *Gothic*.)

Hence it is, that when the water of a river hath ſome of its parts ſo obſtructed, the depth is increaſed by ſo much as the obſtructed water riſes to; and, on the other hand, when the breadth of a river increaſes more and more wide, the depth of water is diminiſhed, the ſame quantity of water being ſpread over a larger ſurface, which diminution is always in proportion to the increaſe of the rivers breadth.

I have further endeavoured to anſwer this *quære*, as its of material conſequence to the navigation, and muſt in a manner decide the *choice* of the ſeveral *plans* now offered; and this by an exact menſuration of all the voids and ſolids of the preſent bridge, as it now ſtands; and alſo, the firſt deſign of *three* ſemicircular *arches*, on the old foundation, *viz.*

Of the old Bridge.	Feet	In.	*Of the new Bridge.*	Feet
Redclift Arch —	24	0	Redclift Arch —	37
Lightermans Ditto —	26	0	Center Ditto —	45
Chapel Ditto —	26	0	St. Nicholas's —	37
St. Nicholas's —	22	6		
Sum of Voids	98	6	Sum of Voids —	119
Redclift Pillar —	24	8	Redclift Pier —	9
Chapel Ditto —	35	4	St. Nicholas's Ditto	9
St. Nicholas's —	26	6	New-Key Walls	48
Sum of Solids	86	6	Sum of Solids	66
River's Breadth	185	0	River's Breadth	185

Now, the ſum of the voids of the old bridge is, 98 feet, 6 inches, which multiplied by the mean depth of 16 and a half, aforeſaid, the product is 1625 cubical feet, and 3 inches, the true water-way runing through the bridge at that time.

The ſum of the voids of the new bridge, is 119 feet, which muſt alſo be multiplied by the mean depth of 16 feet and a half, the product is 1963 feet, ſix inches, thereſore, deduct the cubical feet in the voids of the old bridge, from the voids of the new bridge, and the difference is 338 cubical feet

3 inches in favour of the new bridge, which is an addition of more then 1-fifth, and equal to the difference of the water obſtructed by the old pillars.

This impediment being thus removed, will prevent the ebbing and flowing of the tide, with its uſual velocity, as above a fifth more water will paſs through the arches, in the ſame ſpace of time, with greater freedom; and this more ſo in my other deſigns, to the no ſmall improvement of the navigation.

Thus Gentlemen, I have endeavoured to prove, that whenever any part of the water of a river is obſtructed, ſuch water will flow, or raiſe itſelf on the free-water up the river, until it hath gained a paſſage over the free-water, equal to its own obſtruction; and therefore, that the leſs ſuch obſtruction is, the leſs height will the obſtructed water be raiſed to, and conſequently the leſs will be its fall, after having paſſed ſuch impediments, (*an article that ought to be principally obſerved.*)

It may not be amiſs to furniſh you with an account of the aſſcents and deſcents of the ſtreets; alſo, a liſt of the buildings neceſſary to lay open the avenues to the Bridge, *&c.* * are as follows, *viz.*

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* REMARKS on the ſection of the ſtreets, as they now are; and, as they will be when compleated, according to any one of my deſigns, viz.

62 feet from St. Maryport-Street, ſouthward, is 1 foot, in 15 and a half.

100 feet to the ſhambles, is 1 foot in 8 $\frac{96}{138}$.

59 feet 7 inches, (to Mr. Taylor's, Cutler,) 1 foot in $7\frac{1}{102}$.

114 feet from Mr. Taylor's, towards the Back, is 1 foot in $21\frac{24}{61}$.

50 feet to the entrance of Baldwin-ſtreet, is 1 foot in 50 foot.

60 feet from Mr. Taylor's towards the bridge, is $3\frac{3}{4}$ inches in 15 foot.

117 feet to the center of the bridge, is 1 foot in $41\frac{10}{14}$.

90 feet from the center of the bridge, ſouthward, is 1 in 40.

80 feet ditto, is 1 foot 32 feet $\frac{17}{41}$.

35 feet from the interſection of the 4 ſtreets back again is 4 inches.

If altered according to any of theſe deſigns, the Streets will be as follows, viz.

221 feet 7 inches from St. Maryport-ſtreet, to Mr. Taylor's, will be 1 foot in $10\frac{132}{157}$.

164 feet from Mr. Taylor's to the entrance of Baldwin-ſtreet, will be 1 foot in $17\frac{64}{112}$.

122 feet 6 inches from Mr. Taylor's to the Abuttment of the new bridge, will be 1 foot in 40 feet 10 inches.

80 feet 6 inches to the middle of the bridge, will be 1 foot, in 19 feet.

190 feet from the middle of the bridge, to the interſection, of the 4 ſtreets, will alſo be 1 foot in 19 feet.

The center Arch will be raiſed 3 feet higher than the preſent Arches; and 1 foot 8 inches higher than greateſt Tides, which now buries the old Arches 16 inches.

N. B. It may be here noted, that although the ſoffeit of this new Arch, will only be raiſed 3 feet higher than the old Arches, yet the road in the middle of the bridge will be raiſed 4 feet 8 inches higher than the preſent road; becauſe the thickneſs of the old work from the under ſide of the navigable Arch, to the upper ſide of the road, is only 6 feet 4 inches; whereas, the new bridge will require to be 8 feet, viz.

Crown

	Feet	In.
Crown of the ſingle Arch-Stones, (under par) *	5	8
Paving and Mortar, over Ditto,	0	4
Water-Pipes,	0	6
Rubble	0	10
Pennant Covering	0	8
	8	0

Purchaſes neceſſary for opening the Avenues, to the New Bridge of Briſtol, *agreeable to my firſt Scheme.*

Twenty Houſes now ſtanding on the Eaſt-Side of Briſtol *Bridge, from St.* Nicholas-Gate, *to* Tucker-Street.

	£
* 1	30
* 2	40
* 3	40
* 4	35
* 5	20
* 6	18
7	26
8	20
9	20
* 10	20
11	30
12	20
13	16
14	14
15	12
16	20
* 17	30
* 18	20
* 19	14
* 20	25
	£ 500

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* The Deſign of 3 Arches will require the ſame depth, 8 inches excepted, if a Counter-Arch is bounded over them, to deſtroy their lateral Preſſure.

Twenty-Seven Houſes, ſtanding on the Weſt-ſide of BRISTOL-BRIDGE, from *Redclift-Street*, to the *Conduit*, on the *Back*.

	£
21	90
22	20
23	12
24	20
25	14
26	19
27	18
28	14
29	12
30	12
31	12
32	18
33	10
34	25
35	24
36	20
37	20
38	16
39	28
40	18
41	24
42	20
43	14
44	12
45	25
46	40
47	25
	£ 582

Two Houſes in *Tucker-Street*.

	£
* 48	34
* 49	36
	£ 70

Carried forward — £ 652

Nine Houſes in St. *Thomas-Street.*

	£
Brought forward	652
50	20
51	16
52	10
53	4
54	4
55	4
56	6
57	6
58	13
	83
St. Thomas-Street,	83
Tucker-Street,	70
Eaſt-Side of the Bridge,	500
Weſt-Side of Ditto,	582
	1235
Firſt Scheme	1235
Second ditto	532
Sum Total, per Annum	£ 1767

N. B. *The Houſes mark'd thus *, are neceſſary to be taken down for compleating the Avenues leading to and from the Temporary Bridge.*

◆ ◆ ◆

Additional

Additional Purchaſes neceſſary for compleating the Avenues to the New-Bridge, agreeable to my ſecond Scheme.

Thirty-Six Houſes, on the South-Side of the Shambles, from St. *Nicholas-Gate*, to St. *Peter's-Street*, viz.

		£
1	— —	14
2	— —	20
3	— — —	12
4	— —	7
5	— — —	15
6	—	15
7	—	8
8	—	9
9	—	18
10	— —	11
11	— —	7
12	— —	14
13	— — —	5
14	— —	10
15	— — —	6
16		8
17		8
18	— —	16
19	— — — —	7
20	— — — —	14
21	— — — —	7
22	— — —	6
23	— — —	6
24	A Stable, and two Slaughter-Houſes,	4
25	— — —	20
26	— — —	4
27	— — —	4
28	— — —	6
29	— — —	5
30	— — —	12
31	— — —	8
	Carried forward — £	306

VII.

Of Models, *and their appendant* Machines, *neceſſary for re-building* Briſtol-Bridge; *and a ſhort Deſcription of the Method and Size of the Materials to be uſed in the Courſe of this Work*, &c.

THERE is in Architecture, as well as in Geometry, an eſſential difference between one *thing*, and being *nearly* ſo. Drawings are therefore very uncertain things to determine your judgments by, *unleſs well ſkilled in practical and experimental knowledge.)*

	Brought forward — £	306
32		20
33		20
34		14
35		6
36		38
	Shambles —	404

Five Houſes on the Eaſt-Side of *Dolphin's-Lane*, viz.

		l.	s.
37		36	0
38		10	10
39		60	0
40		7	0
41		15	0
	Dolphin's-Lane £	128	10
	Shambles — —	404	0
	Second Scheme — £	532	10

And, I am poſitively convinc'd, that many *drawings* which captivate, and appear ſtriking, would diſcover great imperfections, if a perfect *model* of them was neatly executed; which never fail to render buildings (of any kind) more familiarly intelligable than *words* and *drawings* can poſſibly do.

I have therefore after much ſtudy, repeated trials, and unwearied application, compleated ſuch *models*, and their appendant *machines*, as will in a great meaſure demonſtrate their own uſefulneſs.

Theſe *models* and *machines* are of ſuch a complicated kind, and afford ſuch a variety of mechanic powers and operations, though all upon the moſt ſimple principles) as can but very imperfectly be deſcribed in words the beſt choſen; what little, therefore, is hereto ſubjoined, I deſire may not be underſtood as intended for a minute deſcription, but only as a ſuccinct account of them.

The *Firſt Model*, is the conſtruction of a *Wooden Temporary-Bridge*, leading from the Shambles-ſide, over the great Pillar (whereon Mr *Bright*'s parlour ſtands) to *Tucker-ſtreet*, exhibiting at one view the mechanical connection of every piece of timber contained in the whole Bridge; by which a judicious eye will ſee that its ſtrength is full ſufficient to ſupport any weight that can poſſibly be ſuppoſed ever to paſs over it, whilſt the under works are equally ſtrong to reſiſt the torrents, without too much obſtructing the navigation.

The whole ſo artfully contrived, that it may be framed, raiſed, and compleatly finiſhed *(if begun at a proper ſeaſon)* in about 6 months, built with *Dantzic* timber, plank'd with three-inch oak, boarded up the ſides with inches and quarter red-deal, and cover'd with ballaſt ſtain'd; or pitching, 13 inches high, or deep, from the upper ſide of the planking, with convenient receſſes *.

The ſecond, is a compleat *Model* of a New *StoneBridge*, of 3 ſemicircular Arches, ſtanding on a ſtrong grating 2 feet below the bed of the river, on the old foundation; ſhewing every ſtone in the whole bridge, both plain and ornamental, with the proportions annexed, *viz.*

Middle Arch	45	Feet,
2 adjoining ditto,	37	each,
2 Piers . . .	9	each,
Abutments . .	12	each.

The piers to terminate at the ſalient angles, in a right one, and over the point, on each end of the pier is a *ſemi-octagonal ruſticated bow*; which may, in ſo ſhort a bridge as this, be omitted: But, for the following reaſons, I have here introduced them, in order, in the *firſt* place, to have the points, and the middle of the piers, as equally loaded as poſſible, which will contribute to the ſecurity of the whole.

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* I believe ſome Expence in this Bridge may be ſaved, by covering it with the rubble from the old houſes: And alſo, to make uſe of only two bearings, or ſupports, between the banks, inſtead of three, as expreſs'd in this Model.

Secondly, To ſtrengthen the *arches*, by oppoſing ſo much more weight or reſiſtance againſt their *Thruſt*, or *lateral Preſſure*; for it is very demonſtrable, that the lighter an *arch* is, in proportion to its piers, or what comes to the ſame) the heavier the piers are, in proportion to the arch; the firmer the arch will be; and, the contrary vulgar opinion, *viz. That the more an* arch *is loaded, the* ſtronger *it will be*, is a groſs error. *Thirdly*, Theſe ruſticated bows, beſides the real advantages already mentioned, do very much add to the decoration of the fronts of the bridge, by dividing, or breaking a ſtraight line the length of the bridge, into as many parts as there is arches. *Fourthly*, becauſe theſe bows being carried quite up, the block cornice, and parapet walls, *&c.* made to follow their out-line, will afford uſeful and commodious receſſes for the foot paſſengers, where they may retreat, if any buſineſs, or accident requires, there ſtopping, without embarraſſing the foot-way, as it happens but too often in the ſtreets.

The arches ſpring about 6 feet above low-water-mark, which will make the aſcent of the bridge 1 foot in 19, if continued from *Redcliff-ſtreet*, to the ſummit of the *Bridge* (as I apprehend it ought to do,) by which means *High-ſtreet*, near the *Gate*, which is now ſo ſteep as to be 1 foot in 7 $\frac{1}{101}$, may be made as eaſy as 1 foot in 10 3-quarters, or very nearly ſo; and the turning down to the *Back*, will be only 1 foot in $17\frac{64}{112}$, *admitting* St. Nicholas's-Gate *to be rebuilt, or taken quite away* *.

It

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* Having ſlightly mentioned St. *Nicholas*'s-*Gate*, I will ſay ſomething relating to the church; but, muſt firſt beg pardon of the Gentlemen of that pariſh, and hope that they will conſider what may be ſaid, is, againſt the ruinous condition, and bad ſituation of that fabric, is not againſt them. I ſhall therefore attempt to offer a few obſervations, and remarks, with no other intention than that of ſerving the Public, as an individual of this City; and one, who loves and wiſhes well to the Church and Poſterity; which, I hope, will be a ſufficient appology to Gentlemen of their candor and integrity.

To erect a Noble Bridge, for a ſafe and open paſſage; and afterwards, to ſtraiten and incommode that Paſſage, by rebuilding the *Gate*, ſo as to make it difficult for Two Carriages to paſs each other, without endangering the lives of the drivers, the horſes and paſſengers (or, at beſt, to make them fly for ſecurity) muſt be very abſur'd, in that, it perverts and deſtroys the benefits that can accrue from a well-built Bridge, were the ground a level ſpot, on which the Gate ſtands, it would much contribute to the conveniency and beauty thereof; but, that's impoſſible to be ſo done; the expences of rebuilding this *Gate*, with *ſmall* one's on each ſide, *&c.* has been eſtimated at 850 l. and, when compleated, would be joined to an old ruinous, and inconvenient Church; which will appear obvious to every candid man, who will, with care and attention examine, and plumb the upper-walls with judgment. I will venture to affirm for a truth, that with the addition of 1250 l. to the above ſum, join'd to the old materials; to re-build that Church, and ſo conſtructed, as to hold at leaſt a fifth more people than it can at preſent; and they more commodiouſly ſituated, it being a *Plan I ſaw executed*, *when* on my travels through the Province of *Penſilvania*, in *America*. This Church will make *a good appearance*; the *Gate* being taken quite *away*; the Alter-Piece, Organ, and all the

Burial-

It may be obſerved, that the aſcents and deſcents of all the avenues, to each *of my* deſigns, *are exactly the ſame; notwithſtanding the* plans *differ ſo much in themſelves.*

The Breadth of the bridge, as confined to the old foundation (from out to out) is 44 feet,

Burial-Ground intirely preſerv'd: The whole *to be* ſtrongly built, and compleatly finiſhed, in *Twenty Six Months*, the *Tower* excepted, as that ſtands firm and well, as does the *Spire* alſo, (which is a very good piece of carpentry).

I will further engage, to ſupport the practibility of the above, by making an exact *Model* of the Church, Tower, Pewing, Galleries, *&c.* (if required) and to produce workmen that will contract to compleat it, in the above time, for the above ſum.

This propoſition will, I hope, be taken ſome little notice of, by the Gentlemen of St. *Nicholas*'s Pariſh, unleſs the old Church and Gate ſhould be ſo rivited to their breaſts, that they will not depart from it: For, I beg leave to ſay, that nothing hitherto has been thought on, that will ſo effectually compleat the *Avenues* to the Bridge; and ſo greatly add to the Elegance of the whole. Yet, if any man ſhould differ from me in *Opinion*, he will do well before he determines, to have recourſe to *Facts* and the *Model* I offer; and, if theſe which I have collected from meaſurements, ſurveys, ſtudy, and figures, ſhould be found to be genuine, a difference ſhould ſtill ſubſiſt by any one, let him or them, lay their hands on their breaſts, and weigh them over again.

And if, at the ſame time, ſelf-intereſt, or ſome worthy endearing friendſhip for the intereſt of others, ſhould have yet, ſome ſmall poſſeſſion there, let him, for a moment wrench it out; and, like *Brutus*, endeavour to do a ſervice to our *Church*, and *Fellow Citizens*. But, after all that has been ſaid on this ſubject, I had rather ſee the Model of the Church of St. *Stephen*'s, *Walbrook*, *(London)* compleated in *King-Street*, *(Briſtol)*: 'Tis built on a Circular Plan, and is eſteem'd by all Architects that have ſeen it, as a matchleſs pile of Art; and, it may be executed for a moderate Sum.

feet, which is diſpoſed of in the following manner:

	Feet.	Inch.		Feet.	Inch.
Parapet	1	9	doubled	3	6
Footway	6	9	ditto	13	6
Carriage	27	0		27	0
			Whole breadth	44	0

The footway raiſed 10 inches above the road: Alſo a range of ſtone poſts on each ſide, with a running chain, by way of defence to foot-paſſengers.

Here the carriage-way is ſufficient for three coaches and two horſemen to paſs a-breaſt, without danger: But the plans of 5 arches, and that of a ſingle one, may be built to any breadth required.

The external parts of theſe deſigns to be built with *Portland* and *Felton-ſtone*; the inſide of the *piers*, ſpandrels, and chain-courſes ſolid, with *Bath-ſtone* or *Dundry-rag*; and the internal parts with *Up-river-ſtone*. Theſe materials will make the beſt of work, eſpecially if the larger ſtones be laid not only in the plinths, but in the firſt, ſecond, and third courſes; and that the ſmalleſt ſtone be not leſs than half a ton (a cloſer excepted); that they be well bedded, truly level, and well faſtened together with iron cramps ran in with lead; and all the outſide joints be well ſet in ſtrong *Pennorth* or *Aberthaw lime*, mixed with clean ſand, will be equally as good as the *Padua mortar*, or *Pozzoli* *terrace*, and will prevent the iron-work from being ever affected by the water; ſo that the work of each pier, and the abuttments, will be almoſt as ſtrong, as true, and as compact, in their ſummerings and bearings, as if the whole were built of one entire ſtone.

The ſoffeit of the arches to be turned quite thro' with the ſame large ſtones as in the fronts.

It will alſo be of great conſequence, over each pier and abuttment, to make a drain to carry away the water and filth, which in time may penetrate into, and accumulate in thoſe places, to the great detriment of the arches.

But if you ſhould be induced, from a *motive of cheapneſs*, or any other reaſon, to diſregard the above *obſervations*, and to introduce a different pile of building, ſo far as it regards the choice of *materials*.

I have nothing to offer, ſo proper as the following method, without running into extremes, *viz.*

To build the piers, arches, ſpandrels, chaircourſes, parapets, *&c.* with *Up-river* ſtones.

Theſe materials, well laid in proper courſes, will make tolerable good work.

The reſt of the *maſonry*, between and over the chain-courſes and inſide ſpandrels, may be filled up with the following *compoſitions*, that is, 12 parts of terras, 6 of large-grain'd ſand, 9 of unſlack'd lime, 15 of ſtone-ſplinters (about the ſize of an egg) and 3 parts of glaſs-houſe cinders.

This kind of *mortar*, or *beton*, will conſolidate into a ſtrong and ſubſtantial body, ſo as to reſiſt the water from penetrating it, which may be carried down the ſpandrels to the piers and abuttments.

Theſe materials, united with care and judgment, will undoubtedly make a cheap, rough bridge.

But what a falling-off would here be, when compared with the former method, which would not fail to make the *firſt deſign* equal to that laſting bridge over the *Bacbilione* at *Vicenza*.

The *ſecond*, to ſurpaſs the new bridge of *Compeigne* over the *Oiſe*.

The *third*, to vie with the fam'd *Senatorian bridge* of ancient *Rome*:

And the *fourth*, no way inferior to that maſter-piece of art, the *Rialto*, over the great canal at *Venice*.

The truth of this will appear, from the following ſolid reaſons, *viz.*

Firſt, That the piers and abuttments are built on the old foundation, that will not, in all human probability, ever ſettle *.

Secondly, That the outſide materials are not only of the beſt ſort of ſtone, but alſo the heavieſt in *England*; (ſome kinds of *marble* excepted.)

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* Although the old Piers have width ſufficient to admit of the new piers, to be placed on them; yet, they do not anſwer ſo well for length.

Thirdly, The ſize and diſpoſitions of the materials being ſuch, that there will be no falſe bearings, or even a falſe joint in the whole bridge. Every part will be fully and properly ſupported; and what ought to be of one ſingle ſtone, is not here made of ſeveral, as is too frequently done.

Fourthly, That, inſtead of ſmall ſtones and rubble, with which the inſide of moſt bridges are filled, all the *piers*, *arches*, *ſpandrels*, *chain-courſes*, and a certain part of the *abuttments*, are propoſed to be entirely built with ſolid blocks of ſtone, properly ſecured with *iron cramps*, run in with *lead*, well ſet in good *cement*, and certain parts of the inſide filled with *Up-river* ſtone.

Fifthly, By the precaution of building the arches quite thro' with the ſame ſort of large ſtones as in the fronts.

Sixthly, To provide for their future ſecurity, by proper drians. Some bridges have been ruined for want of this precaution, which ſhould be obſerved in all conſiderable bridges, and yet is to be found in very few.

To which may be added, a *ſeventh Reaſon*, *viz.*

Over the firſt arch may be turned another, two or three times thicker at the reins than over the key; ſo calculated and built, that by the help of this ſecondary arch, together with the incumbent load of materials, all the parts of every arch will be in *equilibrio*; that is to ſay, the *thruſt* or *lateral preſſure*, which all arches have, more or leſs, according to their figure and conſtruction, exert to overſet their piers, will, by a proper diſpoſition of the materials, be entirely counter-ballanced and deſtroyed; ſo that each arch, thus built, will ſtand ſingle, without affecting or being affected by each other. I ſaw this curious invention put in practice at *Weſtminſter-bridge*, which entirely prevented the whole ſeries of arches from falling into ruins, before their time, when the 5th pier was taken down and rebuilt, after all the arches were turned, *&c.* and what added ſtrength to ſtrength, was the joints in the ſpandrels preſerving a tendency to the center. This manner of filling the ſpandrels of the arches is moſt preferable to the common way, which is, *to fill what is above the arch-ſtones in the fronts with horizontal courſes, and to fill the inſide with rubble laid at random.*

It is ſurpriſing, that this manner of arching has not been put in practice ſo often as it might. However, I will mention a few *examples*, where the ſame good *precaution* has been obſerved: The great arch at *Venice*, 98 feet ſpan. The great arch at *Vicenza*, 110 feet ſpan. A groin arch at *Blenheim*, built in this manner, which ſtands firm and well, tho' it has only 3 and a half feet riſe upon 44 feet ſpan. And all the arches of the *Pont-Royal* at *Paris*, ſo much cried up by the *French*, and ſo juſtly praiſed, on this account.

Third model is an *engine for driving the piles*, conſiſting of one upright ſhaft, one wheel, four pullies, and one weight, beſides the *ram*; the whole framed together on a lighter or ſtage, and may be uſed by either men or horſes. This method of driving piles has been highly eſteemed; for which reaſon it will be ſufficient for me only to mention, that, having calculated the effect of this engine, I found, that ſuppoſing the *ram* to weigh 1200 lb. and the height of the ſtrokes at a mean 16 feet perpendicular, the engine would give about 26 ſtrokes per hour by the help of 4 men, and about 48 ſtrokes per hour by the help of two horſes. This effect being much ſuperior to that of any of the engines commonly uſed for this purpoſe, was the chief reaſon that determined me to drive the piles in this manner: for tho' the expence of this engine will be conſiderably more than that of any other ſort, and will take up a great deal of time in making; yet I know, if the *third deſign* ſhould take place, as alſo a *ſecond bridge*, it will make us good amends, by the expedition and other conveniencies, attending this manner of driving piles upon a floating ſtage.

Fourth, is a Machine for ſawing off the piles under water, cloſe to the ground. This little *apparatus* is ſo contrived, that it may always be uſed, while the water is in a ſtate between 6 and 13 feet deep.

Fifth, is a Model of a Machine for laying the foundations of the piers in the moſt ſubſtantial and expeditious manner; and, erecting them with almoſt the ſame eaſe as on dry land, without obſtructing the navigation, turning the river, or making uſe of *batterdeaux*, or *coffer-dams*. This Machine for building the Piers, is a kind of Cheſt, floating on the water like a veſſel, (or as the *French* call it *Caiſſion*) in the form of a *Concave Parallelopipedon*, of dimenſions equal to the baſe of the pier that is to be raiſed; the ſides of this *Caiſſion* are made ſo ſtrong as to prevent being preſs'd in by the ambient-water, and are fixed on a ſtrong grating or grillion of joice, about 12 inches ſquare, of firr-timber, placed horizontally, about 12 inches aſunder, with joice of the ſame dimenſions laid on them at right-angles, with 6 inch plank, well pinned and bolted down to the joice, *will be an immoveable (if not an unperiſhable foundation, to build and ſink the ſtone-piers upon*; the ends of 16 of theſe joice are continued one foot beyond the outſide, on which are fixed ſtraps of oak, 8 by 5, with a roller at the bottom of each, to take off the friction, which hold faſt together the ſides and bottom very ſecurely.

Within this *Caiſſion*, workmen may work, although 10 or 12 feet below the ſurface of the water. During the time the men are building the pier in the *Caiſſion*, others are employed in pulling down and ballaſting away the old foundation under ground, as low as may be judg'd neceſſary, and made truly level, which is done by the help of a number of gauges, each of which conſiſt of a ſtone, about 15 inches ſquare, and 3 inches thick; in the middle of which to fix a wooden-pole, or ſtem, about 13 feet long, divided into feet or inches, from the bottom of the ſtone upwards, the pole to be painted red, and the numbers white, the eaſier to diſtinguiſh when the level ſurface of the water, which will intercept equal portions of thoſe *gauges*. The examination of the bottom's level, muſt be performed by the help of thoſe *gauges*, which muſt be applied to every part of the bottom ſucceſſively, in ſo regular a manner, as to be certain not to leave one ſingle ſquare foot in the ſurface of the foundation untried. When this is done, and the pier built as high as the ſpring of the arch, which will be above low-water; and when brought to its place, and the ſluice opened, the water runs in, and the *caiſſion* ſinks. But, ſhould it ſo happen, that, by ſome unforeſeen miſtake, the pier does not ſtand true; in that caſe, ſhut the ſluce, and pump out the water, and the *caiſſion* will float again as before. This may be repeated as often as it may chance to fail; but when it ſinks into its place truly level, two men may, with levers, purchaſe off the 16 ſtraps in an inſtant of time, which will give liberty to clear the ſides from the bottom: The conſequence of which is, that the ſides muſt riſe by their own levitation or buoyancy, leaving the grating under the ſtone pier, upon the old foundation; ſo that the ſame ſides will do for all the piers, were the number treble : Therefore nothing further is required to be done, but to provide a new grating for each pier.

Sixth and laſtly, is a *Model* of a *Single-arch'd bridge*, whoſe chord is 145 feet, and altitude 43 feet 8 inches, once deſign'd to ſpand the river, from Sir *John Hawkins's-Lane*, to the oppoſite ſide (fronting *Dolphin-Lane)* with a curious center, contrived to leave the navigation free, the whole impartially conſidered, ſo as to ſhew, at one view, the true, (but ill,) effect of ſuch a bridge ſo ſituated, with a plan and ſection of the river, and avenues from *Temple-Croſs*, to the higheſt ground in *Dolphin Lane* ; as alſo the various ſtratums and their different conſiſtencies, 31 feet deep, before you have a firm foundation, *&c.*

It would be almoſt endleſs to remark every advantage, ariſing from the uſe of theſe *models* ; for, although they ſeem to bear the appearance of being compleat in all their parts, yet, by a careful review of them, I can eaſily diſtinguiſh opportunities for conſiderable improvements and additions, ſo as to render every ſubject ſtill more perfect and compleat.

In ſhort, the benefits of theſe *models* are as well known as the neceſſity of them, in being not only the means of ſaving much time and money to the Public, but of conveying to you Gentlemen (Commiſſioners) a juſter comprehenſion of ſo great and uncommon an undertaking, than any Drawings, Schemes and Figures can poſſibly do ; and be the moſt certain method of preventing many errors in the proſecution of the work; beſides, being a great aſſiſtant to the workmen, in forming their different eſtimates for contracting, *&c. &c.*

I am very ſenſible there are many other particulars, which want of time, and very probably my want of *Capacity*, have not been ſuggeſted. But theſe, I ſhould imagine, are the greater number, and of the greateſt conſequence to the public. And,

The following ſhort Journal will, I hope, be of the greateſt conſequence to myſelf and family, *whether I am farther conſulted about the* Bridge *or not*, viz.

I voluntarily embark'd in the ſervices of the Public, about the middle of the year 1757, and made ſome uſeful Obſervations and Remarks on the Old-Bridge, as it was then much the topic of converſation; and the opinion of many that it would certainly be ſoon rebuilt, *&c.*

In the year 1758, I had the honour of being legally called into the ſervice, by the Gentlemen of the *Corporation-Committee*, when by unwearied diligence and indefatigable perſeverance, I attended at the *Council-Houſe*, with divers (neceſſary) Plans, Elevations, Sections, Eſtimates, Levels, Meaſurements, and Surveys, relating to the different Schemes for rebuilding the ſaid *Briſtol-Bridge*, &c.

During the year 1759, I was continued and further employ'd in the ſervice of the Public, by the *Bridge-Committe*; which likewiſe produced a number of new Schemes; with thoſe I attended conſtantly at the *Guild-Hall*; but, as the moſt of theſe Schemes have been made public by the *Committee*, in their *Report*, renders it entirely needleſs for me to enlarge on that ſubject.

The latter part of the year 1759, down to *July* the 27th, 1760, I have been cloſely engaged in contriving, making, and improving thoſe uſeful models (as before-mentioned *) and now think it no improper ſeaſon to make this application for my reward, as it would be impracticable for me to beſtow ſo much time, attendance, ſtudy, and expence, as I have done, in purſuit of mechanic powers and operations, of this nature, if I might not reaſonably expect public encouragement, for what ſo manifeſtly tends to the public benefit; and as the views of thoſe, who ſeek the real improvement of *Art*, are ſeldom highly mercenary, I preſume my own will appear as little ſo as thoſe of any other artiſt whatever.

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* Alſo, in viſiting ſeveral Farmers, living near the different Quarries about the Country, in order to be informed on what terms they would deliver the Stones per tun, at *Briſtol*, (ſuppoſing they ſhould be called upon) an *Article* abſolutely neceſſary for me to be maſter of, eſpecially in forming (hereafter) the ESTIMATE. I likewiſe made a journey into *Wales* to enquire after the famous *Lime-ſtone*, produc'd at *Pennorth* and *Aberthaw*; alſo, to ſee the ſingle Arch Bridge, over the *Taaff*, in *Glamorganſhire*, built by Mr. *Edwards*, and Mr. *Williams*: And, though they contracted to build it for ſuch a ſum, and that it ſhould ſtand firm and well for ſeven years (as it certainly will.) Yet, in my humble opinion, it will remain a Bridge many Sevens. Here the above *Lime-Stone* performs wonders; the Arch-Stones being only 2 feet 6 inches long.

☞ I have ſlightly mention'd theſe Journies, that you might the better Eſtimate the trouble I have been at on this occaſion.

I ſhall leave this conſideration to the honour of the *Committee* at large, of whom I have the higheſt opinion; therefore, doubt not of receiving a reward adequate to my trouble, *&c. &c.*

I have continued this diſcourſe much longer than was at firſt intended; and perhaps may be cenſured for ſaying more than is thought needful: Though I had rather be under an imputation, for ſaying too much than too little, on ſuch a complicated ſubject, as every Gentleman is at liberty to add, ſubtract, alter or amend, any part that offends him, provided it is done with propriety and ſtrict regard to the whole. Indeed, I ſhall as ſoon expect to ſee a ſhoe made to fit every foot, as a propoſal of this kind to ſuit the opinion of every perſon. I ſhall not, therefore, I hope, be ſuſpected of preferring, even in my own conceit, what is hereby addreſſed to you, to any thing reſulting from the Abilities and Study of any other Perſon upon this public Occaſion.

Thus, Gentlemen, have I preſumed to lay before you theſe few thoughts, and am ready to communicate them, in the moſt familiar manner, by *drawings*, working *models*, *machines*, and *eſtimates* (when honoured with your Commands) for the effectual performance of this moſt laudable and uſeful *ſtructure*; which, when compleated, will be the nobleſt *ornament* of this *City*; while it cannot fail to perpetuate your *Memories* to the lateſt Poſterity.

I muſt not ſay more: Pompous profeſſion, juſtly raiſes prejudice: *Reaſon* and *Candour* will not pretend to judge without examination: To your deciſion, I do therefore moſt willingly ſubmit the fate of this, however favourite attempt; nor ſhall paternal partiality preſume to breathe a diſcontented *murmur* at your *ſentence*, being confident, that your *Opinion*, concerning the ſeveral *Deſigns* now offered, will be faithfully given, in a manner ſuitable to the importance of the ſubject, join'd to a ſtrict regard to *Public Juſtice*, and the character of Gentlemen,

Your moſt Obedient, and

moſt humble Servant,

James Bridges.

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F I N I S.

ADVERTISEMENT,

WHEREAS, it is a general Complaint, founded on Practice, that moſt Buildings when finiſh'd, have coſt the Proprietor double the Sum he at firſt intended to lay out, or was made to believe it would coſt at his firſt engaging; which, diſcourages many Gentlemen from applying their Thoughts to *Building*, eſpecially, as the uſual Method of carrying on Work of this kind, is generally attended with great Trouble, Time and Perplexity, the Building often ruin'd, and the Gentleman quite diſpirited. To theſe Truths, many more may be added; but, from whence proceeds all theſe Difficulties, and how they are to be avoided, is obvious, *viz.* They generally proceed from *Indeliberation* in the *Proprietor*, he not having well digeſted his *Plan*, before he lays the Firſt Stone; and oftentimes, a want of *Ability* in the Builder, in forming the *Eſtimate*, (*the great Deluder*:) But often, and much oftner, for want of a *Model*, from which ariſes almoſt every other Evil. Drawing Lines and Figures, anſwer very well for the exterior Parts, and for the Out-

Lines of a *Plan* ; but more ſubſtantial Matter is required to deſcribe the inner Diviſions of a Building : A *Model* in Wood, will anſwer the Purpoſe with more certainty, and be much leſs liable to deceive, and more intelligable to the Proprietor, than a Figure upon Paper. This is the Advice of all good *Architects*, and, it ſhould be the Practice of all honeſt Builders ; we ſee it done for all great Buildings, and there is no Reaſon why it ſhould not be for the leaſt, the Charge will always be proportion'd, and therefore, in ſmall Undertakings will be little, and it will always give great Satisfaction to the Proprietor. There has been a Cuſtom, when great Works are to be undertaken, to beſtow a large Expence upon *Models* ; but, this is very Wrong, it is employing Fancy upon a Work, wherein all ſhould be the Effect of Judgment ; for the *Model* is not to be admired in itſelf, but, to convey a diſtinct Idea of what will be convenient, and admired in the Houſe : Its Plainneſs therefore, ſhould be its Recommendation. The Imagination of the Proprietor is not to be captivated b *Ornament* in this little Piece ; but, it is to ſhe him what is the intended Diviſion of all th Parts in the Houſe, with perfect Plainneſs, tha he may ſee what to approve, and wherein to propoſe an Alteration.

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THE larger ſuch a *Model* is the better, becauſe the Parts will be the better underſtood by an unexperienced Eye; and, as I adviſe perfect Plainneſs in it, the Expence will be trifling: It is a very needful Charge, and the ſparing of which, is commonly ſeverely repented in the carrying on of the Building *.

THEREFORE, to prevent theſe Errors (for the future) and to promote and facilitate Building as much as I poſſibly can, I purpoſe to undertake, and compleatly finiſh any *Dwelling-Houſe*, in a limited Time, from 1000 to 5000 £, according to the following Rule, or Table, *viz.*

The Expence of finiſhed Drawings, from 1000 to 5000 l.			The Expence of Models from 1000 to 5000 l.			The Expence of rough Drawings & Models, from 1000 to 5000 l.		
l.	l.	s.	l.	l.	s.	l.	l.	s.
1000	5	5	1000	6	6	1000	10	10
1500, to 2000	6	6	1500	7	7	1500	11	11
			2000	8	8	2000	12	12
2500, to 3000	7	7	2500	9	9	2500	13	13
			3000	10	10	3000	14	14
3500, to 4000	8	8	3500	11	11	3500	15	15
			4000	12	12	4000	16	16
4500, to 5000	9	9	4500	13	13	4500	17	17
			5000	14	14	5000	18	18

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* The *Model* I made for THOMAS TYNDAL, Eſq; is ſuch as is here recommended; the Conſequence of which was very happily felt in the Courſe of that Work.

CONDITIONS,

FOR Attendance on any Gentleman, into the Country, to receive Inſtructions, or, to View the Spot of Situation, *&c.* *One-Pound, One-Shilling*, per *Day*, and all Expences found; (and ſo in Proportion.)

N. B. Should it ſo happen, that the Proprietor and I cannot agree, I am to be paid for my *Drawings* and *Models*, agreeable to the above Table, *&c.*

If we agree, I am not to Charge for *Drawings* or *Models*, but to receive One-third of the Sum agreed on, at ſigning the Articles; One-third at Covering the Roof; and the remaining One-third when finiſh'd.

If employ'd to act as Surveyor (on my uſual Commiſſions of *Five* per *Cent.*) the *Model* only to be charg'd,

BRITISH MUSEUM

By their humble Servant,

JAMES BRIDGES,

BUILDER and ARCHITECT.

⁂ In order to Contract as low as poſſible, I have engaged the beſt of Workmen, on very reaſonable Terms.